Studies on the Biology of some Freshwater Fishes

Part V. *Mystus vittatus* (Bloch)

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(With nine text-figures)

Introduction

Mystus vittatus (Bloch) is one of the commonest Indian catfishes. It is abundant in all types of freshwater environments. The serrated pectoral spine, unless held carefully can cause injury and for this reason, the species is locally known as 'Katua' or 'Katia', meaning thorny. The fish is small sized—the largest specimens recorded by Day (1878) were 18·8 cm. to 21·3 cm. long. Estuarine specimens measured by Prabhu (1956), were of 16·5 to 17·5 cm. in length. At Aligarh the largest specimen recorded by the author during the 16 months observations, was only 15·4 cm. long. The colour of the fish differs in different environments and Day (1878) has figured two varieties. He says about the colours:

> Silvery or golden, old specimens at Madras have a light bluish band along the middle of the side, and a narrow light one above and below it, a dark shoulder spot, and sometimes another near the base of the caudal fin. More to the eastward as Orissa and Bengal the colours are more vivid, usually of a golden hue, with a black shoulder spot, a narrow black band along either side of the lateral-line, a lighter parallel one below, and two wider ones above. Sometimes these fish appear to be dark, with 5 longitudinal silvery bands. Tips of fins usually dark.

At Aligarh the specimens were of both types. Those which came from rivers, particularly from the River Ganga and its irrigation channels, were dull coloured with lighter bands; but those which came from the weedy ponds were brightly coloured with darker bands. The light coloured fishes when kept in aquaria developed dark bands after some days. *Mystus vittatus* has a wide distribution and occurs throughout India, Burma, Siam and Ceylon (Day 1878).

Little attention has been given towards the biology of this fish and barring a few comments on its spawning season (Prabhu 1956; Qasim & Qayyum 1961), there is no other information available.

Material and Methods

Samples were collected in the second half of each month, from the Aligarh fish market, and the investigation was spread over a period of 16 months, from September 1962 to December 1963. The fish were preserved in 10% formalin and examined as soon as possible. The techniques of examination were the same as described earlier (Bhatt 1970).

Length Frequency Distribution

Since the fish has no scales, and no other hard structure of the body had annulations as growth checks, the length frequency distribution alone was used to get some information on the growth rate (Fig. 1).

From Fig. 1 it is difficult to identify the various modes, excepting perhaps from the histogram of January-March, where two modes can be seen, and from the histogram of April-June, where three modes can be distinguished. This probably indicates that the maximum longevity of this fish is about 2 to 3 years. The progression of various modes in different quarters could not be followed.

Breeding

Like other species, in this fish also, the classification of gonads into 5 maturity stages was made according to the scheme adopted by Qayyum & Qasim (1964) which is arbitrarily based on the shape, colour, size and weight of the gonads.

Size of fish at first maturity

The various size groups falling in different maturity stages have been given in Table 1. It is clear from the table that in males higher stages of maturity appear at 8·0 cm. and in females at 8·5 cm. All the males below 8·0 cm. and females below 8·5 cm. were immature.

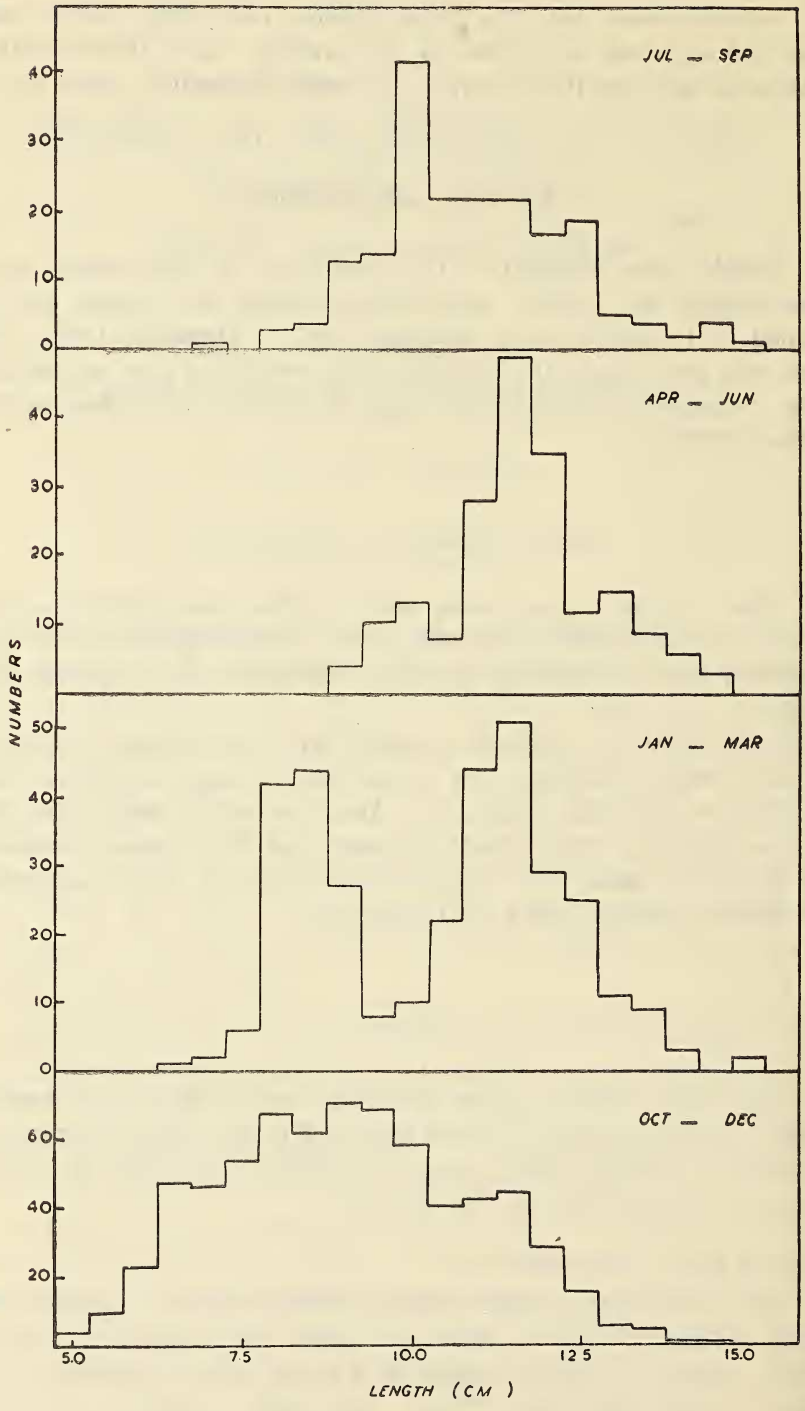

FIG. 1. Length frequency distribution of *M. vittatus*. Each histogram is based on the pooled samples of three months.

TABLE 1

MATURITY STAGES OF *M. vittatus* IN VARIOUS LENGTH GROUPS

Maturity stages	Length in cm.	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10·0	10·5	11·0	11·5	12·0	12·5	13·0	13·5	14·0	14·5	15·0	Total
Male I	..	—	—	1	5	10	8	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
Male II	..	—	—	—	—	—	—	17	25	17	25	18	13	35	51	34	6	5	5	—	—	—	251
Male III	..	—	—	—	—	—	—	—	—	1	1	6	7	3	12	6	2	—	—	—	—	—	38
Male IV	..	—	—	—	—	—	—	1	1	6	5	4	3	2	2	5	4	1	—	1	—	—	35
Male V	..	—	—	—	—	—	—	—	1	4	3	4	2	2	4	1	—	1	—	—	—	—	22
Total	..	—	—	1	5	10	8	19	27	28	34	32	25	42	69	46	12	7	5	1	—	—	371
Female I	..	—	2	1	8	7	8	11	1	—	—	—	—	—	—	—	—	—	—	—	—	—	38
Female II	..	—	—	—	—	—	—	—	26	42	40	50	33	41	33	21	24	15	12	8	3	—	348
Female III	..	—	—	—	—	—	—	—	—	—	2	13	8	6	17	14	8	4	—	1	2	—	75
Female IV	..	—	—	—	—	—	—	—	1	—	4	—	2	7	10	8	15	5	4	2	4	—	62
Female V	..	—	—	—	—	—	—	—	—	—	6	—	8	6	15	5	—	1	1	—	—	—	42
Total	..	—	2	1	8	7	8	11	28	42	52	63	51	60	75	48	47	25	17	11	9	—	565

Sex-ratio and sex-dimorphism

During the period of investigation about 1420 specimens were sexed by internal examination. Of this, 594 were males and 826 females. Thus the ratio of males to females was about 1 : 1·5.

Some size difference between males and females was also noticed. The maximum size of the male was found to be 14·2 cm. while the largest female was 15·4 cm. in length. Females in general were usually bigger and more abundant in the samples than the males.

Unlike *Mystus seenghala* (Bhatt 1970), sexual dimorphism in *Mystus vittatus* is of a permanent nature and can be easily seen in the males in the form of a genital papilla. This papilla is a projection of the genital aperture and varies from 2 mm. to almost 1 cm. in length. The genital papilla is prominent throughout the year and gets more enlarged during the spawning season. Although its function is not yet known, its presence probably helps in sex recognition during the spawning congregation. Since females lack this structure, it can be utilized for the identification of the two sexes with absolute certainty.

Cycle of maturation and depletion of gonads

Fig. 2 shows the five maturity stages occurring in different months of the year. It can be seen from the figure that the immature fishes (stage I) do not occur throughout the year. This indicates that the fish matures in the first year of its life and that the immature fishes advance towards the next maturity stage (stage II) in March, when they are hardly six months old. The ripening fishes (stage III) appear first in March and their percentage reaches maximum in June and July. No ripening fish is seen after July.

The ripe fishes (stage IV) of both sexes were first seen in June, and their maximum number occurred in August.

The spent males (stage V) were observed, for the first time, in August but the spent females were seen only in September. The maximum number of spent fishes in both sexes occurred in the month of September (Fig. 2). These spent fishes found in September and October are probably late spawners. The males in the spent condition continued to occur till November and December. The occurrence of only spent males in November and December show that recovery in males starts very late. The spent testes continue to remain in a shrunken state having a dull grey colour for a longer time.

From the cycle given above, it can be concluded that the spawning season in this species starts late in August and continues till about September, and is almost over by October. Peak spawning probably occurs in September.

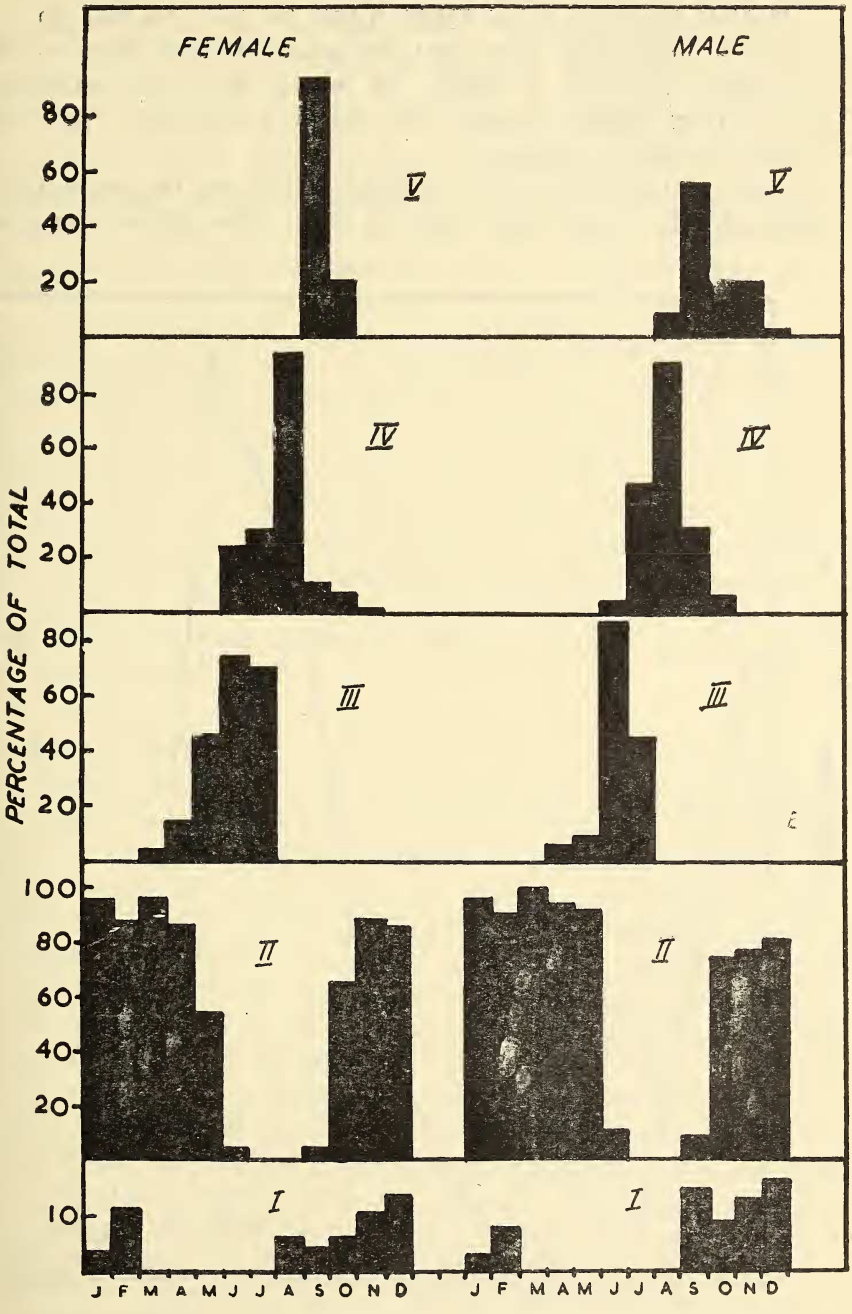

FIG. 2. Percentage of *M. vittatus* at each of the five stages of maturity in different months of the year.

Seasonal changes in gonad weight

Monthly records of gonad weight in both the sexes has been shown in Fig. 3. The figure shows that the gonads of both sexes record an increase in weight in March. In August they reach maximum values. From August onwards they register a rapid fall. This fall seems to be due to spawning.

The gonad weight recorded in October 1962 was far greater than that recorded for the same month in 1963. This indicates that in

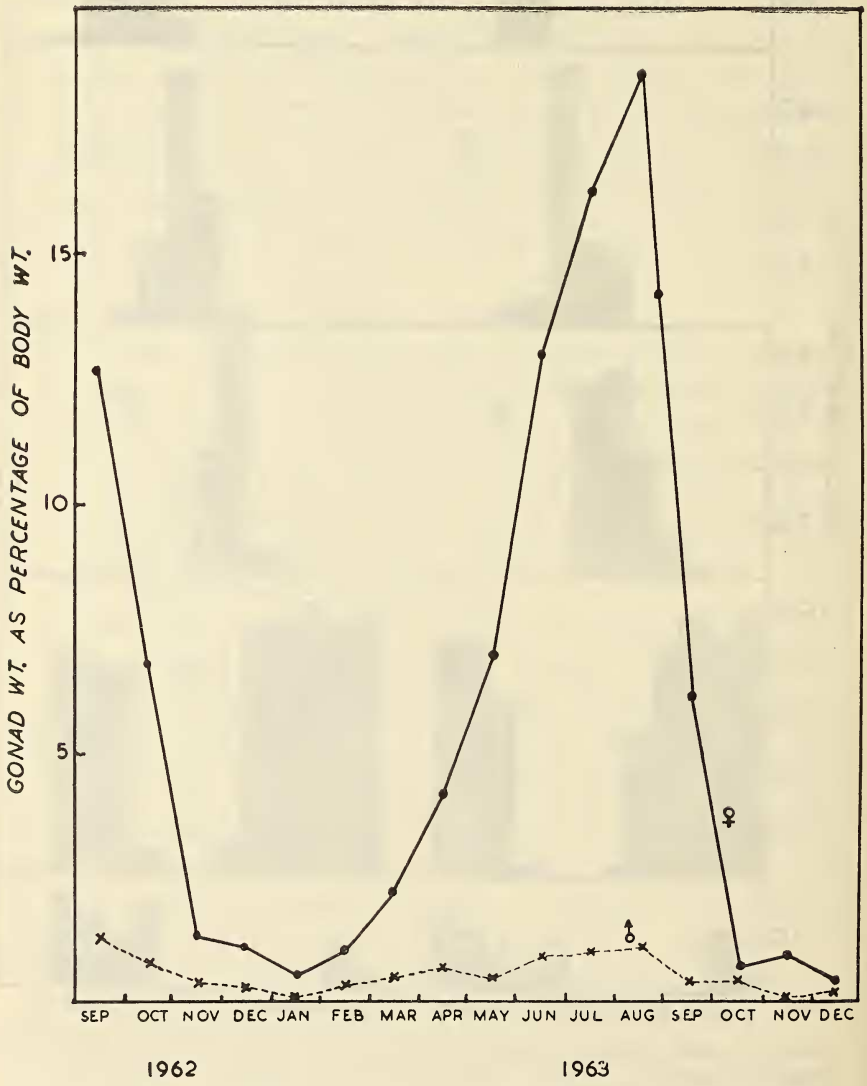

FIG. 3. Seasonal variation in gonad weight as percentage of body weight of *M. vittatus* of males (broken line), of females (continuous line).

1962 the spawning season probably continued till October; but in 1963 was more or less over in September. The second possibility which could lead to such a variation in the gonad weight during the two years of investigation may be because of an inhibition of spawning in a large number of females in October 1962, which probably did not occur to that extent in October 1963. The statement that 'in catfishes too, due to varying conditions of food and shelter prevailing in different ponds, there occurs in some ponds either a delayed spawning or its total inhibition', made by Qasim & Qayyum (1961) seems to be true in this particular species.

While summing up the spawning season of *Mystus vittatus* at Aligarh from the observations on the maturation cycle and the seasonal changes in the gonad weight, it seems important to point out that the months when maximum spawning occurs are August-September. This conclusion differs from the deduction made by Qasim & Qayyum (1961) in the same locality that the time of maximum breeding in this fish is July-August and the probable duration of breeding is June-September. The author did not observe any spent fish in the months of June or July. The spawning season of this species also differs somewhat from that given by Prabhu (1956) as October and November in brackish water.

Spawning periodicity

The ova diameter frequencies were studied from March to August and have been shown in Fig. 4. The figure shows that the maturing batch of eggs gets separated from the original stock in April and forms a mode at 0·60 mm. The maximum size of the eggs in this month is 0·75 mm. In May (Fig. 4 C) there is no increase in the size of eggs and the mode does not shift any further. However, there is a clear increase in the frequency of large-sized eggs. In July the stock of eggs likely to be spawned gets widely separated from the yolkless eggs and the size of eggs becomes uniformly large (Fig. 4 E).

In August (Fig. 4 F) more or less the same condition prevails, but in September no eggs are left in the ovaries. It is, therefore, evident that each individual spawns only once during the season and that there is no periodicity in the spawning. This agrees with the deductions made on the frequency of spawning of this fish by earlier workers (Prabhu 1956; Qasim & Qayyum 1961).

Condition factor

The condition factor of 1420 fishes belonging to both sexes was determined by the formula $K=100/L^3$. The mean 'K' value of adult

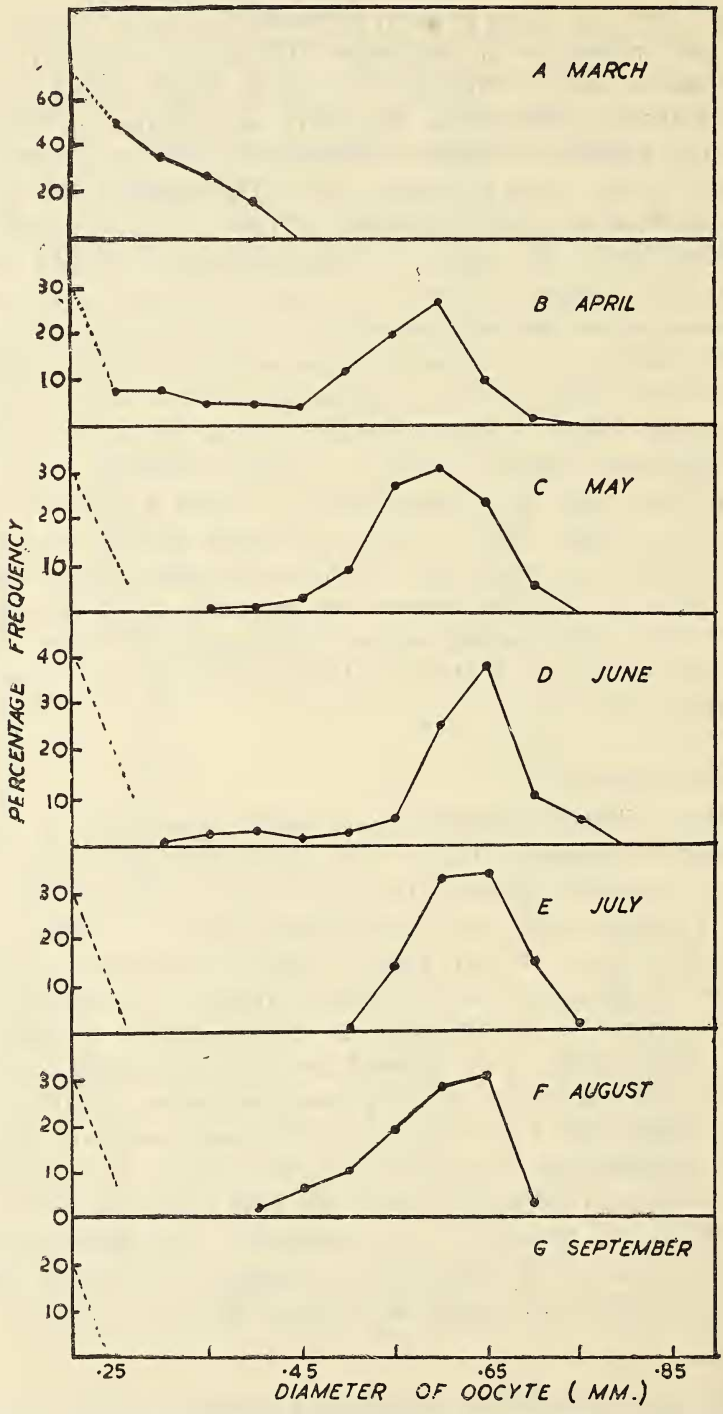

FIG. 4. Size frequency distribution of intra-ovarian eggs of *M. vittatus* from March to September. Broken line indicates the area of small immature eggs which were not measured.

fish (excluding the immature fishes) in different months have been shown in Fig. 5.

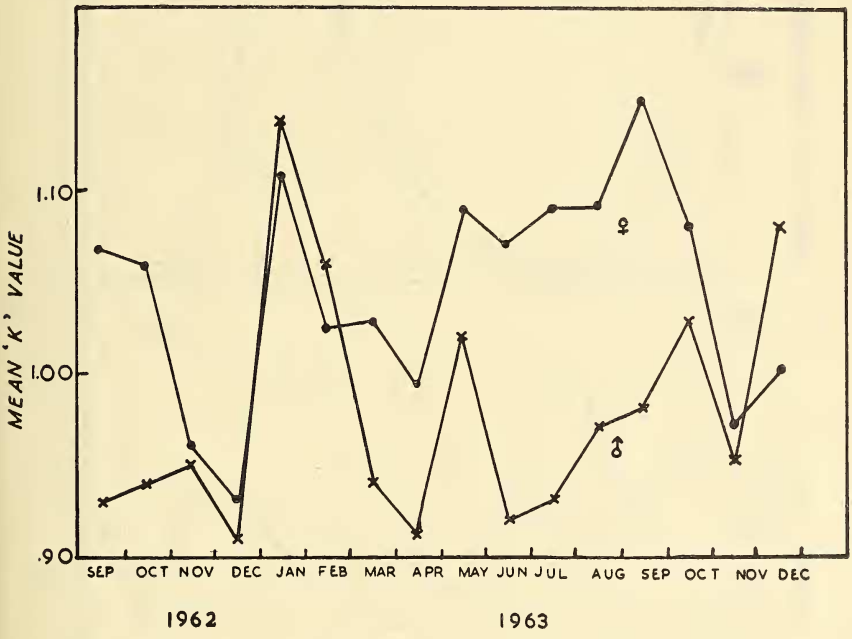

FIG. 5. Seasonal changes in the condition factor 'K' of both sexes of *M. vittatus*, of males x———x, of females ●———●.

A comparison of the seasonal changes in the condition factor with the feeding intensity (Fig. 6 b & c) reveals a high degree of correlation between the two. High feeding rate in January corresponds with the high 'K' value in the same month. In other months also the fluctuations in the feeding rhythm are in close agreement with the 'K' values. It is, therefore, evident that the changes in the 'condition factor' are directly related to the rate of feeding.

A comparison of the 'K' values with the seasonal changes in gonad weight will reveal an entirely different picture (Fig. 6 a & c). The rise and fall in the gonad weight does not seem to be strictly connected with the fluctuations in the condition factor.

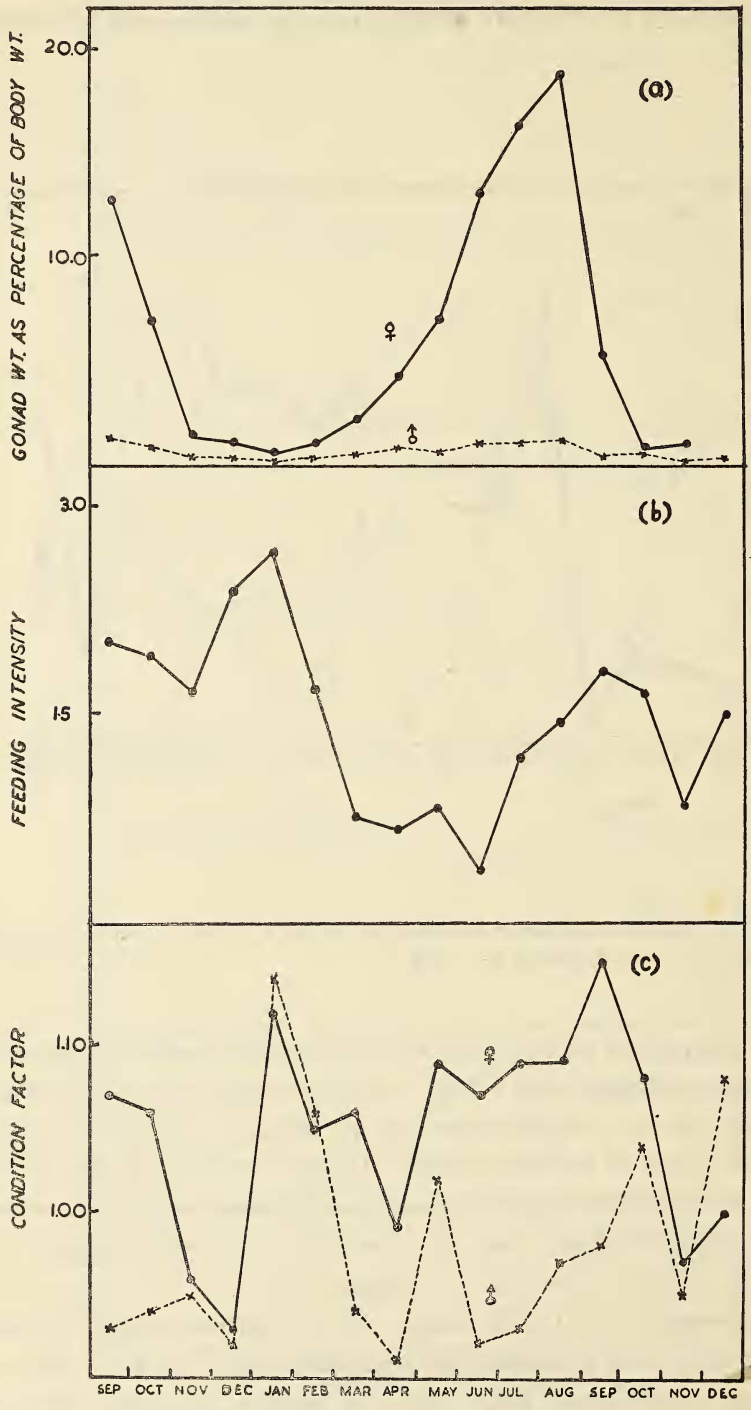

FIG. 6. Seasonal variation in (a) Gonad weight, (b) Feeding rhythm and (c) Condition factor 'K' of *M. vittatus*.

The mean 'K' values of various length groups have been shown in Fig. 7. It can be seen from the figure that there are many points of

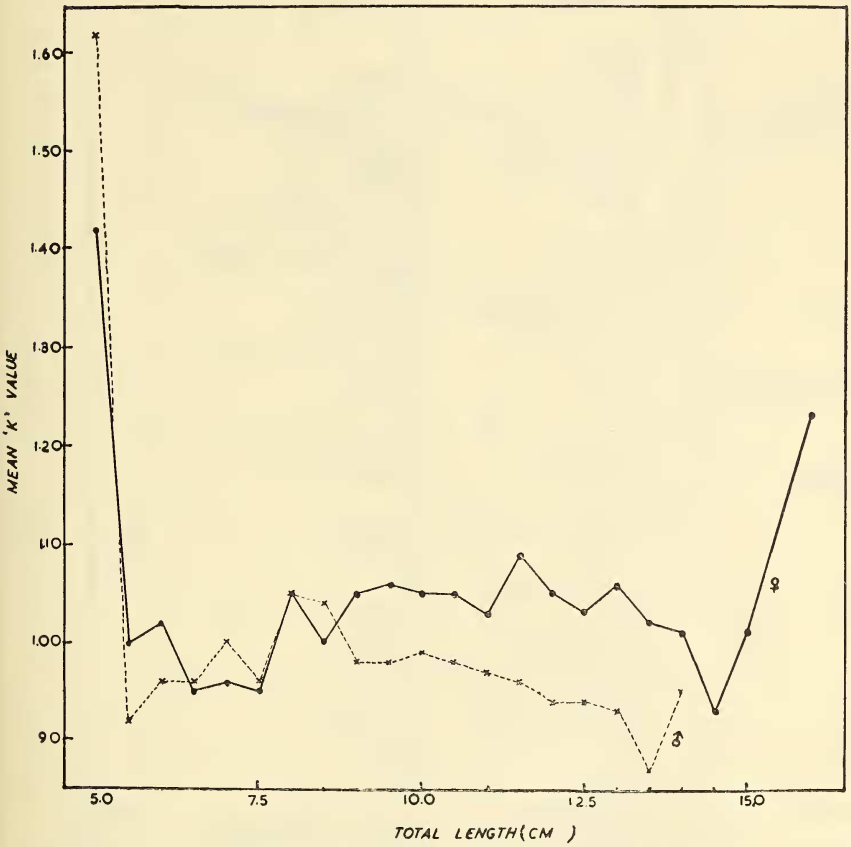

FIG. 7. Mean condition factor 'K' of *M. vittatus* at different lengths of males (broken line) and of females (continuous line).

inflection in the curve and none of these correspond to the size of the fish at first maturity as has been determined by a more direct method (Table 1).

The abovementioned observations on the condition factor of *Mystus vittatus* agree well with those recorded earlier in *Mystus seenghala* (Bhatt 1970).

FOOD AND FEEDING HABITS

Food of *M. vittatus* was analysed over a period of 16 months. During this period 948 guts were examined; of which, 751 were found to contain food and the rest (197 guts) were empty. The monthly

TABLE 2

PERCENTAGE OCCURRENCE OF VARIOUS CATEGORIES OF FOOD IN THE GUTS OF ADOLESCENT AND OLDER FISHES (*Mystus vittatus*)

Food item	Month															
	1962								1963							
	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Insect ..	39·5	25·9	25·8	5·5	5·0	8·0	6·6	3·3	—	—	3·3	13·3	5·6	4·5	3·3	15·1
Insect larvae ..	50·0	44·4	45·1	26·6	13·3	66·6	61·6	76·6	43·3	8·2	58·3	17·7	64·0	9·1	40·0	31·8
Copepods ..	94·7	82·7	79·0	82·2	64·8	95·0	56·6	68·3	63·3	54·0	85·0	48·8	60·0	9·1	58·3	66·7
Daphnids ..	89·5	77·7	45·1	12·2	21·6	36·6	11·6	21·6	33·3	24·5	11·6	28·8	36·0	3·0	30·0	62·1
Fish-fry ..	15·7	6·1	20·9	3·3	1·6	1·6	—	—	1·6	1·6	5·0	2·2	16·0	21·2	20·0	12·1
Rotifers ..	28·9	69·1	27·1	48·8	20·0	81·6	45·0	60·0	25·0	50·8	70·0	26·6	8·0	3·0	33·3	51·5
Crust. larvae ..	—	7·5	12·9	—	—	—	—	33·3	8·3	44·2	70·0	15·5	12·0	10·6	15·0	53·0
Eggs of invertebrates ..	18·4	14·8	46·7	67·7	36·6	33·3	15·0	25·0	48·3	50·8	73·3	33·3	24·0	—	40·0	51·5
Water mites ..	—	18·5	16·1	15·5	8·3	—	—	—	—	—	5·0	6·6	4·0	—	—	—
Algae ..	21·0	12·3	16·1	63·3	10·0	1·6	21·6	5·0	8·3	1·6	8·3	13·3	4·0	13·6	30·0	39·4
Cypris ..	71·0	17·2	20·9	27·7	—	13·3	5·0	—	8·3	68·8	46·6	28·8	—	12·1	15·0	15·2
Sand & mud ..	36·8	4·9	35·4	3·3	21·6	23·3	—	18·3	—	19·7	23·3	13·3	—	21·2	31·6	15·2
Prawn & Shrimps ..	—	—	8·1	7·7	8·3	—	—	—	—	—	—	—	—	18·2	3·3	1·5
Debris (unidentified food) ..	42·1	65·4	45·1	83·3	46·6	71·6	61·6	50·0	40·0	45·9	56·6	44·4	20·0	48·5	46·5	65·2
Higher aquatic plants ..	—	—	—	—	—	—	—	—	13·3	—	1·6	6·6	12·0	9·1	23·3	10·6
Molluscs ..	—	—	—	—	—	—	—	—	—	—	—	20·0	—	1·5	—	—

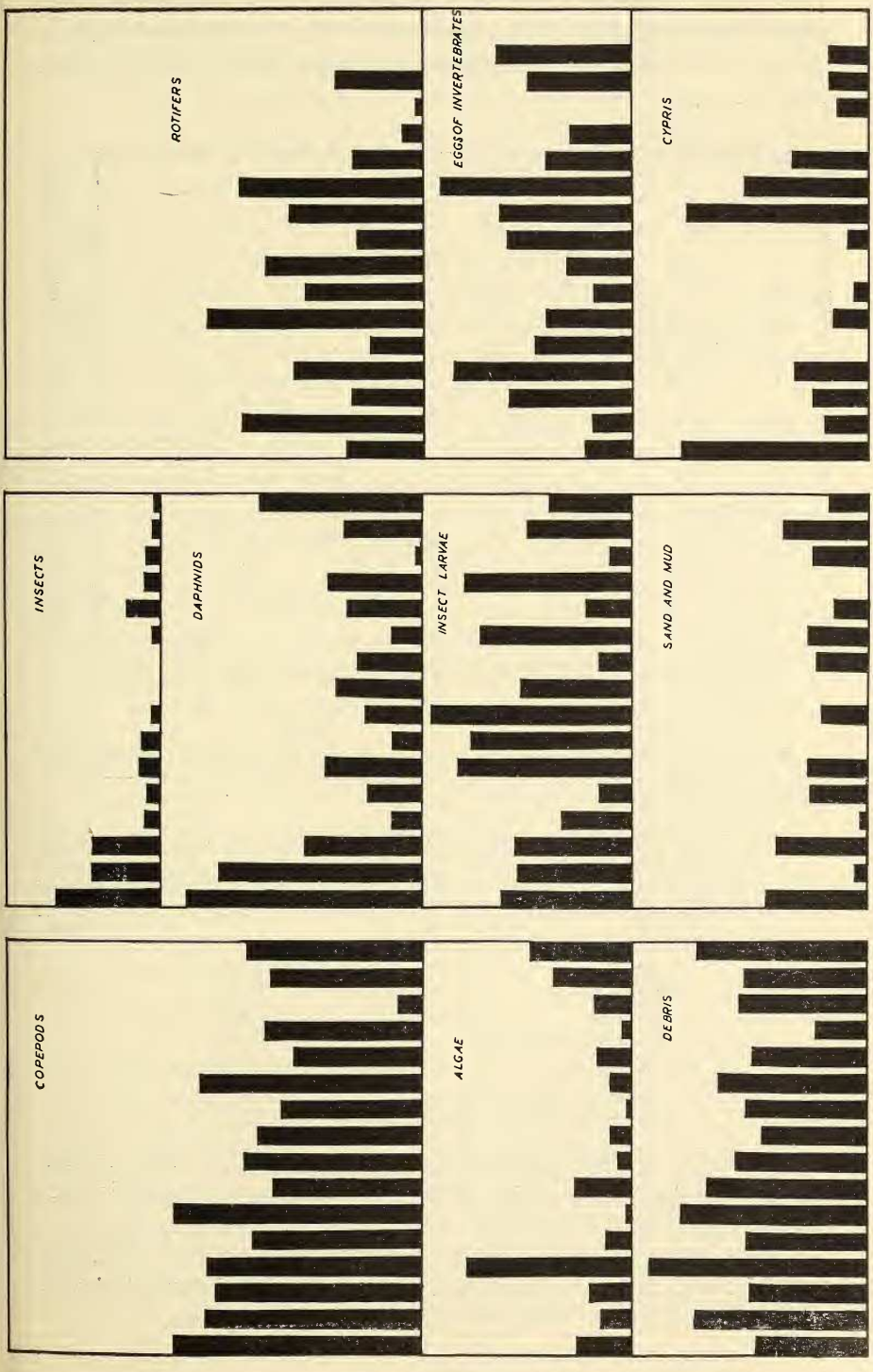

FIG. 8. Histogram showing the percentage occurrence of various categories of food items of *M. vittatus* in different months.

percentages of various categories have been given in Table 2 and the main food items have been illustrated in Fig. 8. The total food as percentage of body weight along with the empty guts have been shown in Fig. 9.

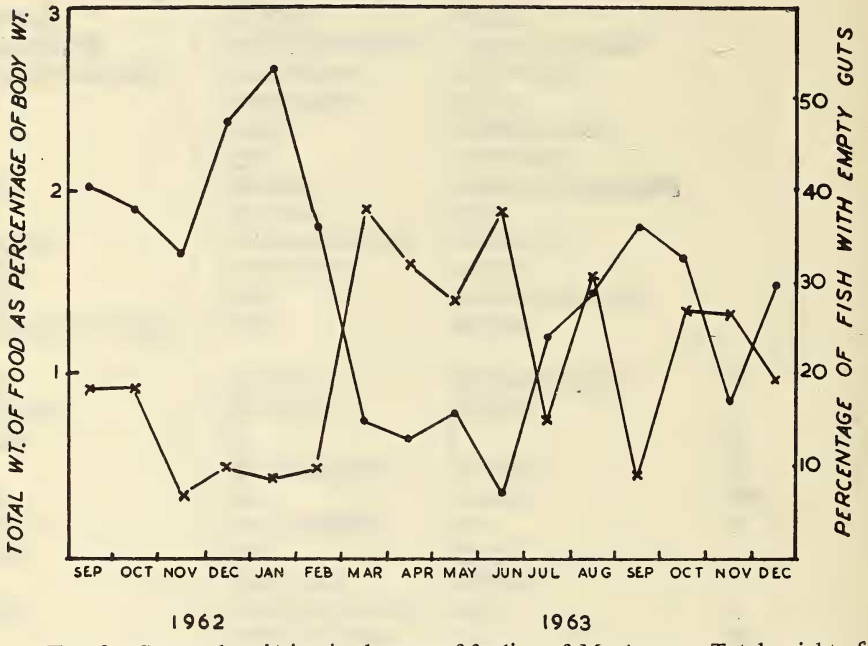

FIG. 9. Seasonal variation in the rate of feeding of *M. vittatus*. Total weight of food of adolescent and older fishes as percentage of body weight, ●———● and percentage of empty guts x———x.

The food items of specific importance were the copepods, insect larvae, daphnids, rotifers, eggs of invertebrates, cypris, algae and debris. These food items occurred in the gut regularly. Their percentages in the total number of guts were as follows:

Copepods	.. 66·2%
Insect larvae	.. 41·4%
Rotifers	.. 40·6%
Eggs of invertebrates	.. 36·2%
Daphnids	.. 34·1%
Cypris	.. 21·8%
Algae	.. 16·8%
Debris & Unidentified food	.. 52·1%

Copepods recorded the maximum percentage (66·2), and occurred throughout the year. Cyclops predominated, and their monthly percentage ranged from 9·1 to 94·7.

Insect larvae occurred in 41·4% guts and their monthly percentage varied from 9·1 to 76·6. The insect larvae were mostly dipteran (chironomid and mosquitoes). Dragonfly nymphs were rarely seen.

Rotifers were also abundant in the gut and their total percentage was 40·6. Daphnids were also very common but these were not as abundant as copepods. The crustacean larvae included mostly nauplii and other developing stages of copepods and daphnids.

The eggs of invertebrates occurred in 36·2% guts. Their presence in each month was more or less constant. Most common eggs were those of daphnids, copepods and chironomids. The eggs of mosquitoes were rarely seen.

Cypris occurred in 21·8% guts. Their occurrence was not very steady and they did not occur in large numbers.

Algae showed a relatively low percentage in the gut (16·8%). These included *Microcystis*, *Spirogyra*, *Ulothrix* and *Oscillatoria*.

Debris and unidentified food items were grouped together and kept separately. The percentage of these was about 52·1.

Other food items included insects, fish-fry, water-mites, shrimps, weeds and small molluscs. These items were not regularly seen but in some months their proportion was quite high. Of these, insects, fish-fry and algae require special mention. Insects were represented mainly by terrestrial forms (Diptera and Ephemeroptera). Aquatic insects (*Nepa*, *Notonecta*, etc.) were rarely seen. Fish-fry showed greater percentage in the post-monsoon months. Scales, spines (in one specimen), muscles of fish, leg of frog (in one specimen) were also found in the guts. Higher aquatic plants were rarely seen. In one specimen a ground-nut was also found. Molluscs, earth-worms, shrimps and water-mites were very rare.

Seasonal variation in the rate of feeding has been shown in Fig. 9. It can be seen from the figure that there are two phases of active feeding. One from July to October and the other from December to February. The period of minimum feeding is during summer, i.e. from March to June which coincides with the gonad maturity and spawning.

Summary

Length frequency distribution of *M. vittatus* gave evidence of 2 to 3 modes. Both sexes mature at the end of first year of life. At maturity the males are 8·0 cm. and the females 8·5 cm. long. Seasonal changes in the gonad maturity revealed that this fish spawns from August to September. Seasonal changes in gonad weight confirmed the spawning season. Each individual spawns only once during the breeding season. The variation in 'K' values seems to be correlated with the feeding intensity of the fish. There seems to be no

correlation between the seasonal changes in gonad weight and the 'K' values.

The main food items of *M. vittatus* are insect larvae, copepods, daphnids, rotifers etc. The food items show little variation from season to season. There are two distinct phases of active feeding. Minimum feeding occurs during summer months, just prior to spawning.

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